SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, July 20.—"The Influence of Phase Changes on the Tenacity of Ductile Metals at the Ordinary Temperature and at the Boiling Point of Liquid Air." By G. T. **Beilby** and H. N. **Beilby**, B.Sc. Communicated by Prof. J. Larmor, Sec.R.S.

The observations recorded in this paper are intended to prepare the way for a more direct attack on the problems of molecular cohesion by the establishment of clearer views as to the influence of changes of phase on the tenacity of ductile metals at various temperatures.

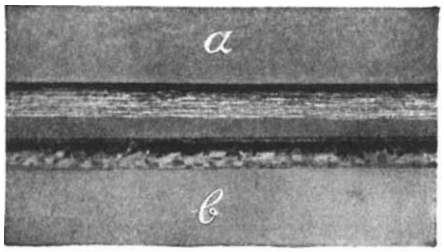

FIG. 1.

FIG. 2.

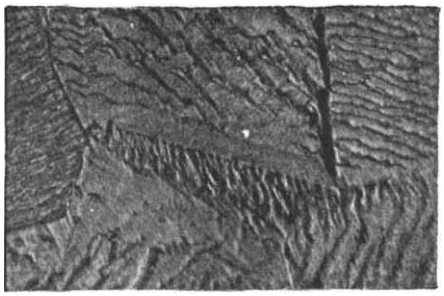

FIG. 3.

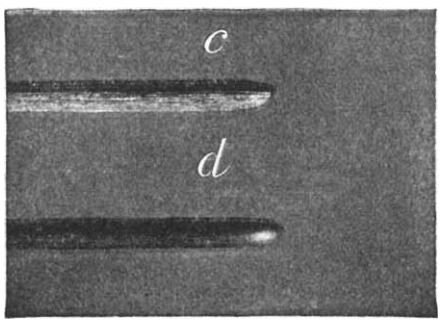

FIG. 4.

According to the phase theory of the hard and soft states in metals which was first developed by one of the authors more than a year ago, the changes of state from hard to soft and from soft to hard were shown to be due to the changes of phase brought about, in the one case by heat, and in the other by mechanical deformation or flow. In the ductile metals the crystalline is the mechanically unstable phase, while the amorphous only becomes thermally unstable when a definite temperature is reached.

The comparative mechanical instability of the two phases is well illustrated in the stretching of wires under tension. Annealed wires, which are in the **C** phase, stretch when they are stressed beyond the yield point; hardened wires, which are partly in the **A** phase, do not stretch—they break without extension when their limit of tenacity is reached.

The homogeneous **C** phase in ductile metals has no true breaking point—it yields and stretches when stressed beyond the elastic limit, and in so doing it passes partly into the **A** phase, and rupture occurs at the breaking point *of the mixed structure*. The tenacity of the mixed structure approaches, but never quite reaches, that of the homogeneous **A** phase. For the purpose the authors had in view it was necessary to obtain the metals as nearly as possible in this homogeneous condition.

Wire drawing was the means employed for the breaking down of the **C** phase. After a wire had been stretched to four or five times its original length by drawing it through the holes of a wire plate, all the ordinary traces of crystalline structure disappeared, but it still consisted of minute granules of the **C** phase embedded in a matrix of the **A** phase. Further drawing at the same temperature alters the mixed structure only slightly; for each temperature there appears to be a certain mechanical equilibrium between the phases. By lowering the temperature of drawing, the **C** phase is further broken down into still smaller granules, and the mixture approaches more nearly to the homogeneous **A** state.

(*a*) Fig. 1 is a photograph of a gold wire which has been etched after drawing. The flow lines near the surface consist of rows of granules. (*b*) On the same photograph, shows the effect of heating another piece of the same wire to about 400°. Removal of the surface by etching now discloses the fully developed crystalline grains with their differently oriented lamellæ. The thermal transformation from **A** to **C** has taken place, and the wire is restored to the soft condition. Figs. 2 and 3 are photomicrographs at higher magnifications, which show the details of structure more fully. Fig. 2 is the granular structure by oblique light at a magnification of 250, and Fig. 3 is the crystalline structure by normal light at a magnification of 700.

The observations were made on wires which had been as completely as possible converted into the **A** phase by wire drawing at the ordinary temperature, and in every case the tenacity observed was higher than any which had been recorded by previous observers for equally pure metals.

	Tons per square inch
Gold. Purity—9,997 per 10,000	
Tenacity at 288° absolute (15° C.)	15·6
,, 53° ,, (−180° C.) ...	22·4
Silver. Purity—10,000 per 10,000	
Tenacity at 288° absolute (15° C.)	25·7
,, 53° ,, (−180° C.) ...	34·4
Copper. Purity—9,996 per 10,000	
Tenacity at 288° absolute (15° C.)	28·4
,, 53° ,, (−180° C.) ...	36·0

The wires broken at the ordinary temperature showed no general stretching. There was a slight extension of from ½ per cent. to 1 per cent., due entirely to a sharp reduction of diameter at the actual point of rupture. At the boiling point of liquid air all the wires stretched from 11 per cent. to 12 per cent. This stretching was uniform over the whole length between the grips. This was confirmed by exact measurements of the diameter at a number of points.

The appearance of the fractured ends revealed several points of interest. In every case the copper wires showed the cupped formation at the extreme end. This formation is evidently due to the lower tenacity of the central core, due to the presence of gas bubbles which have been drawn out into long tubes or cells. The silver wires occasionally showed a slight cupped formation, but in this case the gas bubbles to which it was due were globular, as if they had been evolved at the moment of fracture. The gold wires were practically free from sponginess, and the fractures were almost perfectly viscous (Fig. 4).

By drawing wires at the lowest possible temperatures the authors hope to obtain the ductile metals in their condition of maximum tenacity, and from the figures then

available to be able to calculate the molecular cohesion at the absolute zero.

July 29.—"Studies on Enzyme Action. VIII.—The Mechanism of Fermentation." By E. Frankland **Armstrong.** Communicated by Prof. H. E. Armstrong.

The experiments described, which were begun in the Carlsberg Laboratory, Copenhagen, were undertaken to ascertain, if possible, the manner in which the activity of the various organisms giving rise to alcoholic fermentation is dependent on, or influenced by, the enzymes which they contain. The action of twenty selected yeasts on each of the four hexose sugars glucose, fructose, mannose and galactose, and on the disaccharides cane sugar, maltose and milk sugar, was investigated. All the yeasts tested were able to ferment glucose, mannose and fructose, but quite a number were unable to ferment galactose. It is shown that inability to ferment galactose has nothing to do with the absence from the yeast of any one of the sucroclastic enzymes, since yeasts are to be found which are without action on galactose; in fact, the fermentation of glucose and galactose is brought about by different mechanisms.

The results further indicate that the power of a yeast to ferment mannose, glucose or fructose is clearly in no way conditioned by the presence of a particular sucroclastic enzyme; indeed, it would seem that the occurrence of alcoholic fermentation is altogether independent of the presence of an enzyme—whether free or fixed—able to induce the hydrolysis either of maltose or of sucrose.

The fact that the three hexoses which behave alike have one common enolic form is of utmost significance as an indication that the formation of the enol is the initial stage in the fermentation of the hexose, and that the breakdown of the molecule commences at the terminal carbon atom.

Chemical Society, November 2.—Prof. R. Meldola, F.R.S., president, in the chair.—Molecular conductivity of water: P. **Blackman.**—The stereoisomerism of substituted ammonium compounds: H. O. **Jones.** Wedekind's supposed β-phenylbenzylmethylallylammonium iodide is proved to be in reality *phenylbenzyldimethylammonium iodide.* At present optical activity is the only evidence of stereoisomerism of quinquevalent nitrogen compounds of the type N*abcd*,X, and the hypothesis suggested by the author (*Trans. Chem. Soc.*, 1903, lxxxiii., 1403), slightly developed, is adequate to explain all the known facts.—Note on the fluorides of selenium and tellurium: E. B. R. **Prideaux.** The fluorides of selenium and tellurium are gaseous substances, easily condensable by cold, forming white, snow-like solids. They have the formulæ SeF_6 and TeF_6.—The constitution of glutaconic acid: J. F. **Thorpe.**—Some alkyl derivatives of glutaconic acid and of 2 : 6-dioxypyridine: H. **Rogerson** and J. F. **Thorpe.**—Note on the formation of β-methylglutaconic acid and of αβ-dimethylglutaconic acid: F. V. **Darbishire** and J. F. **Thorpe.**—The influence of water and alcohols on the boiling point of esters. A modification of Markownikoff's method of preparation: J. **Wade.** The Markownikoff interaction proves on investigation to proceed in most cases readily at 100°, and in presence of any strong acid; it may be modified to afford a general and practically automatic method of preparing the lower alkyl esters of such acids as formic, acetic, propionic, and butyric.—Note on bromine fluoride: E. B. R. **Prideaux.** Fluorine when passed over bromine combines with it to form a pale yellow liquid, which freezes to a white solid, melting at −2°, and which probably has the formula BrF_3.—Solution and pseudo-solution: E. **Linder** and H. **Picton.** The authors discuss (1) the physical and chemical properties of colloidal arsenious sulphide; (2) the physical and chemical properties of colloidal ferric hydroxide; (3) dyeing, a phase of coagulation.—The influence of very strong electromagnetic fields on the spark spectra of ruthenium, rhodium, and palladium: J. E. **Purvis.** The general results showed that (1) most of the lines are divided into triplets, and that there is a periodic or rhythmic change in the direction of the vibrations of the constituents of the triplets; (2) some lines become quadruplets, and within certain definite regions of the spectrum their constituents also change the directions of their vibrations; (3) other lines become doublets; (4) the inner member of the triplets is usually the strongest; (5) the strongest spectral lines are not the most widely separated when vibrating in the field; and (6) the decrease in the width of the triplets does not proceed *pari passu* from the less to the more refrangible end of the spectrum.—A volumetric method of estimating the cinchona alkaloids by means of their double thiocyanates: P. W. **Robertson.** Notwithstanding the complexity of double salts of this type, the determination of the amount of thiocyanate removed from solution by the alkaloids forms an accurate and speedy volumetric method of estimating quinine in the commercial drugs and in the assay of the crude cinchona bark.—The osmotic pressure of sugar solutions in mixtures of alcohol and water: P. S. **Barlow.**

Mathematical Society, November 9.—Prof. A. R. Forsyth, president, in the chair.—The De Morgan medal was presented to Dr. H. F. Baker.—On improper double integrals and On the arithmetic continuum: Dr. **Hobson.** In the first of these papers necessary and sufficient conditions are obtained in order that a double integral, of which the integrand becomes infinite at an infinite number of points within the domain of integration, can be transformed into a repeated integral, so as to be capable of being evaluated by successive integrations with respect to two variables. The second paper deals with some criticisms by J. König levelled against the fundamental notions of the theory of sets of points and with the possibility of a general construction of all irrational numbers. It is shown how a general definition of all numbers rational or irrational can be obtained, and that the set of numbers constructed by means of the definition has the essential properties of the continuum, that is to say, it is at once "perfect" and "connected."—On the arithmetical nature of the coefficients in a group of linear substitutions of finite order (second paper): Prof. W. **Burnside.** An irreducible group of linear substitutions being given in any one of its possible forms, it may be possible to choose new variables so that, when expressed in terms of them, the coefficients of the substitutions belong to an assigned domain of rationality. The simplest domain of rationality for which this could be possible is that defined by the characteristics of the group. It is shown that, in general, apart from certain exceptional cases, it is possible to exhibit the group so that the coefficients belong to the domain of rationality defined by the characteristics. The result is obtained without introducing the theory of the reduction of the group when regarded as a permutation-group.—The continuum and the second number-class: G. H. **Hardy.** The paper is a reply to a criticism by Dr. Hobson of a construction for certain transfinite numbers given by the author in the *Quarterly Journal of Mathematics,* vol. xxxv.—On the asymptotic value of a type of finite series: J. W. **Nicholson.**—On an extension of Dirichlet's integral: Prof. T. J. I'A. **Bromwich.**

PARIS.

Academy of Sciences, November 6.—M. Troost in the chair.—On the mixed derivatives of dextrorotatory camphoric acid and on β-campholide: A. **Haller** and G. **Blanc.** The esterification of camphoric acid by methyl alcohol and hydrochloric acid gives poor yields, the acid ester being produced in considerable quantity. By treatment with phosphorus trichloride, the latter forms the corresponding chloride, from which the neutral ester can be quantitatively obtained by treatment with methyl alcohol. The compounds obtained by the action of ammonia and phenylhydrazine upon the chloride are also described, and the preparation of the β-campholide by the reduction of the neutral methyl ester with sodium. The yields of the latter ester are poor, and the attempt to prepare from it an isomeric cyanocampholic acid was not successful.—The evolution of the Tertiary mammals: the importance of migrations: Ch. **Depéret.** The author emphasises the importance of an exact study of the migrations of mammals at different periods in order to explain the appearance of a given group in strata not containing their immediate predecessors, and gives details for the Eocene fauna.—On recurrent convergent relations: Pierre **Boutroux.**—On a certain category of functions: H. **Padé.**—On the impossibility of negative impulse waves in gases: Győző **Zemplén.** An impulse wave is a surface propagated in a

gas the density and velocity of which undergo abrupt variations. Such a wave is not purely adiabatic, even when the gas is isolated from all sources of external heat. In the case of a positive wave the gas itself is a source of heat, and the entropy of the system increases; the inverse case is not possible.—Remarks on the preceding note: M. **Hadamard.**—Researches on gravitation: V. **Crémieu.** It is shown that it is possible to repeat the Cavendish experiment in liquids under conditions equal, if not superior, to those realised in air.—On the electrical conductivity of selenium: Maurice **Coste.** The selenium in these experiments was placed between gold plates 1 mm. apart. The gold has the advantage over other metals of not forming a selenide, the conductivity of which might interfere with the accuracy of the results. If the selenium is rapidly cooled, the resistance is above 50 megohms, but after annealing it falls to some thousand ohms. It has been found that to obtain a selenium that is very sensitive to the action of light it is necessary to have it in the metallic state in a form as compact as possible.—The determination of calorific conductivity: J. **Thovert.**—The ultra-violet spectra of the purins: Ch. **Dhéré.** Thirteen photographs were made on the same plate, the first being the comparison spectrum, the others the absorption spectra of the aqueous solution of the purin considered with progressively increasing thickness. Results are given for 6-oxypurin, xanthin, and uric acid.—On the reduction of oxides and on a new method of preparation of the compound $SiMn_2$ by means of aluminium: Em. **Vigouroux.**—Molecular transpositions and the migration of carboxyl in the dehydration of certain acid-alcohols: E. E. **Blaise** and A. **Courtot.** The ethyl ester of $\beta\beta$-dimethyl-β-phenylhydracrylic acid, under the influence of phosphoric anhydride, gives dimethylatropic acid. The removal of water in this reaction must have been preceded by the migration of the carboxyl group, and furnishes the first example of such a migration.—On the crystallography of a double compound of ammonium chloride and nickel bromide: Fréd. **Wallerant.**—Rheotropism of some hydroids: Paul **Hallez.**—Experiments on the toxicity of eggs: Gustave **Loisel.** The yolks of the eggs of the chicken, duck, and tortoise contain substances which, when injected into the veins, under the skin, or in the general cavity of the body, determine promptly the death of the injected animals.—Contribution to the study of Corti's organ: M. **Marage.**—On the nature of the pigments of the blood: MM. **Piettre** and **Vila.** The author has repeated Nencki's work on the composition of Teichmann's crystals, and obtains analytical results for the substance which vary with varying conditions of preparation, and hence concludes that the formula attributed to the substance is illusory.—Researches on the fatty acids. Experimental lesions: Jean **Camus** and Ph. **Pagniez.**—On the age of the Vire granite: A. **Bigot.**—On the parallelism of the Upper Eocene strata of Biarritz and Vincentin: Jean **Boussac.**—On the storm of July 4 in the district of Orleans: M. **Maillard.**

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 16.

ROYAL SOCIETY, at 4.30.—The Physical and Chemical Properties of Iron Carbonyl: Sir James Dewar, F.R.S., and H. O. Jones.—The Transit of Ions in the Electric Arc: A. A. Campbell Swinton.—First Photographs of the Canals of Mars: Prof. Percival Lowell.—On the Laws of Radiation: Prof. J. H. Jeans.—The Pressure of Explosions. Experiments on Solid and Gaseous Explosives: J. E. Petavel.—The Accurate Measurement of Ionic Velocities: Dr. R. B. Denison and Dr. B. D. Steele.—On Newton's Rings formed by Metallic Reflection: Prof. R. C. Maclaurin.—The Electrical Conductivity of Dilute Solutions of Sulphuric Acid: W. C. D. Whetham, F.R.S.

CHEMICAL SOCIETY, at 8.30.—Silicon Researches, Part ix., Bromination of Silicophenyl Imide and Amide, and Formation of a Compound including (SiN): J. E. Reynolds.—Condensation of Ketones with Mercury Cyanide: J. E. Marsh and R. de J. F. Struthers.—Application of the Microscopic Method of Molecular Weight Determination to High Boiling Solvents: G. Barger and A. J. Ewins.—Green Compounds of Cobalt produced by Oxidising Agents: R. G. Durrant.—Synthesis of Tertiary Menthol and of Inactive Menthene: W. H. Perkin, jun.—Optically Active Reduced Naphthoic Acids, Part i., Dextro-$\Delta^{(2\text{ or }3)}$-dihydro-1-naphthoic Acid: R. H. Pickard and A. Neville.

LINNEAN SOCIETY, at 8.—Contributions to the Embryology of the Amentiferæ: Dr. Margaret Benson, Elizabeth Sanday and Emily Berridge.—On the Ears of certain Sharks: Prof. Chas. Stewart, F.R.S.

FRIDAY, NOVEMBER 17.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Seventh Report to the Alloys Research Committee; On the Properties of a Series of Iron-Nickel-Manganese-Carbon Alloys: Dr. H. C. H. Carpenter, R. A. Hadfield, and P. Longmuir.

MONDAY, NOVEMBER 20.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—First Exploration of the Hoh-Lumba and Sobson Glaciers (Himalaya): Mrs. F. B. Workman.

SOCIOLOGICAL SOCIETY, at 8.—The Origin and Function of Religion: A. E. Crawley.

TUESDAY, NOVEMBER 21.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Photographs of North American Indians: J. S. Chase.—Boomerangs: N. W. Thomas.

INSTITUTION OF CIVIL ENGINEERS, at 8.—On Waterways in Great Britain (*Discussion*): J. A. Saner.

WEDNESDAY, NOVEMBER 22.

GEOLOGICAL SOCIETY, at 8.—On a New Specimen of the Chimæroid Fish *Myriacanthus paradoxus*, Ag., from the Lower Lias of Lyme Regis: Dr. A. Smith Woodward, F.R.S.—The Rocks of the Cataracts of the River Madeira, and the adjoining Portions of the Beni and Mamoré: Dr. J. W. Evans.—The Doncaster Earthquake of April 23, 1905: Dr. C. Davison.

SOCIETY OF ARTS, at 8.—The Cinematograph and its Applications: F. Martin-Duncan.

THURSDAY, NOVEMBER 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Nature of the Galvanotropic Irritability of Roots: Dr. A. J. Ewart and Miss Bayliss.—Some Observations on *Welwitschia mirabilis*, Hooker-f.: Prof. H. H. W. Pearson.—On the Effects of Alkalies and Acids, and of Alkaline and Acid Salts, upon Growth and Cell Division in the Fertilised Eggs of *Echinus esculentus*; a Study in Relationship to the Causation of Malignant Disease: Prof. B. Moore, Dr. H. E. Roaf, and E. Whitley.—A Note on the Effect of Acid, Alkali, and Certain Indicators in Arresting or Otherwise Influencing the Development of the Eggs of *Pleuronectes platessa* and *Echinus esculentus*: E. Whitley.—On Certain Physical and Chemical Properties of Solutions of Chloroform and other Anæsthetics. A Contribution to the Chemistry of Anæsthesia. (Second Communication): Prof. B. Moore and Dr. H. E. Roaf.—(1) On the Possibility of Determining the Presence or Absence of Tubercular Infection by the Examination of a Patient's Blood or Tissue Fluids: (2) On Spontaneous Phagocytosis and on the Phagocytosis which is obtained with the Heated Serum of Patients who have responded to Tubercular Infection, or as the Case may be to the Inoculation of a Tubercle Vaccine: Dr. A. E. Wright and Staff-Surgeon S. T. Reid, R.N.—On the Occurrence of the Heterotypical Mitosis in Cancer: Dr. E. F. Bashford and J. A. Murray.

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